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Prof. J. Wyman
from his friend

L. Agassiz

ON

EXTRAORDINARY FISHES

FROM CALIFORNIA,

CONSTITUTING A NEW FAMILY.

BY

L. AGASSIZ.

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ON FISHES FROM CALIFORNIA, ETC.

ABOUT fifteen months ago, I received a letter from A. C. Jackson, Esq., soon after his return from San Francisco, California, informing me that while fishing in San Salita Bay, he had caught with the hook and line, a fish of the perch family, *containing living young*. The statement seemed so extraordinary, that though an outline of the specimen observed was enclosed, I suspected some mistake, and requested Mr. Jackson to furnish me further information upon what he had actually seen, and if possible specimens of the fish preserved in alcohol. To this enquiry, I received the following answer :

“ I regret much that the information which I sent you avails so little, without the actual specimens of the fish and young ; these however, I have already taken active measures to obtain, and trust before many months to be able to send you at least specimens of the female, if not of the young. I should at the time I caught the fish have preserved them in alcohol, but at that time I was attached to the Navy Yard commission, and was with my comrades industriously prosecuting the examination of the vicinity of San Salita, as to its adaptiveness for a navy yard, and could not leave for San Francisco without suspending the work, and the means for preserving the fish could not be otherwise procured. This explains the apparent culpable indifference which allowed me to omit preserving the specimens. I have sent directions to California to have caught for me several of the fish, and if at the present time (September 16th, 1852) the females were pregnant (which is not probable) to take from one the bag containing the young, and put mother and young in the jar of alcohol, and to put several other females untouched, into the jar also. These specimens will by direction and examination even if they be not pregnant, and if the jar contains no young, determine the truth and accuracy of the statement I made in my former letter on the subject. This fact proved by these specimens, it will be very easy to obtain during the next spring and summer, specimens in all stages of pregnancy. I think, if I remain in the country, I can insure you a sufficiency of specimens, to determine to your satisfaction, the true state of the affair, during the course of the next year. The fish I refer to, in my opinion, does not exist in very great numbers even in the waters of San Salita Bay, for the two which I caught on this occasion were the only ones which I fell in with, though I fished in the same place probably four times. There was a little peculiarity perhaps in the circumstance of my taking them as I did. I had previous to this time, tried

my rod and line, as I mentioned before, four times, always with success as regards groupers, perch, &c., without a sight of the singular fish under consideration. A few days, perhaps a week, after the four trials, and on the 7th of June, I rose early in the morning for the purpose of taking a mess of fish for breakfast, pulled to the usual place, baited with crabs, and commenced fishing, the wind blowing too strong for profitable angling; nevertheless on the first and second casts, I fastened the two fishes, male and female, that I write about, and such were their liveliness and strength, that they endangered my slight trout rod. I however succeeded in bagging both, though in half an hour's subsequent work I got not even a nibble from either this or any other species of fish. I determined to change the bait, to put upon my hook a portion of the fish already caught, and cut for that purpose into the largest of the two fish caught. I intended to take a piece from the thin part of the belly, when what was my surprise to see coming from the opening thus made, *a small live fish*. This I at first supposed to be prey which this fish had swallowed, but on further opening the fish, I was vastly astonished to find next to the back of the fish and slightly attached to it, *a long very light violet bag, so clear and so transparent, that I could already distinguish through it the shape, color and formation of a multitude of small fish (all fac-similes of each other) with which it was well filled*. I took it on board (we were occupying a small vessel which we had purchased for surveying purposes,) when I opened the bag, I took therefrom *eighteen* more of the young fish, precisely like in size, shape, and color, the first I had accidentally extracted. *The mother was very large round her centre, and of a very dark brown color, approaching about the back and on the fins a black color, and a remarkably vigorous fish*. The young which I took from her were in shape, save as to rotundity, perfect miniatures of the mother, formed like her, and of the same general proportions, except that the old one was (probably owing to her pregnancy) much broader and wider between the top of the dorsal and the ventral fins, in proportion to her length than the young were. *As to color they were in all respects like the mother, though the shades were many degrees lighter*. Indeed, they were in all respects like their mother and like each other, the same peculiar mouth, the same position and shape of the fins, and the same eyes and gills, and there can not remain in the mind of any one who sees the fish in the same state that I did, a single doubt that these young were the offspring of the fish from whose body I took them, and *that this species of fish gives birth to her young alive and perfectly formed, and adapted to seeking its own livelihood in the water*. *The number of young in the bag was nineteen, (I fear I mistated the number in my former letter,) and every one as brisk and lively and as much at home in a bucket of salt water, as if they had been for months accustomed*

to the water. The male fish that was caught was not quite as large as the female, either in length or circumference, and altogether a more slim fish. I think we may reasonably expect to receive the specimens by the first of December. But I can hardly hope to get satisfactory specimens of the fish as I found it with young well grown, before the return of the same season, viz., June. By that time I trust the facts will be fully decided, and the results, as important as they may be, fully appreciated."

In a subsequent letter, (dated January 31, 1853,) Mr. Jackson informed me that he had requested Capt. Case, U. S. N., who commanded a sloop of war in San Francisco, and who had also seen the fish, to supply my friend T. G. Cary, Junr., Esq., of San Francisco, with specimens of that fish, should he succeed in getting any. I wrote myself also to Mr. Cary, to be on the look out for this fish.

About a fortnight ago, I was informed by Mr. Cary, in a letter dated San Francisco, August 10, 1853, that after a search of several months he had at last succeeded in obtaining several specimens of this remarkable fish, three of which were sent by express, (which have reached me lately), while a larger supply was shipped round Cape Horn. After a careful examination of the specimens, I have satisfied myself of the complete accuracy of every statement contained in Mr. Jackson's letter of February, 1852, and I have since had the pleasure of ascertaining that there are two very distinct species of this remarkable type of fishes, among the specimens forwarded to me by Mr. Cary. I propose for them the generic name of *Embiotoca*, in allusion to its very peculiar mode of reproduction.

I feel some hesitation in assigning a family name to this type. It is probable that all its members will present the same peculiarity in their mode of reproduction, and that therefore the name *Embiotoca* may with perfect propriety be modified into *Embiotocoidæ*, as *Didelphis* has given its name to a numerous family, the *Didelphyidæ*, after having been for a long time simply a generic name. Should it however be found that other types of this family present various modifications in their vivaporous reproduction, for which the name *Embiotocoidæ* might be objectionable, I would propose to frame some family name from another structural peculiarity of these fishes, not yet observed in any others, the naked furrow-like space parallel to the base of the posterior dorsal fin, separating the scales which cover the base of the rays, from those of the sides of the body and name it *Holconoti*.

The perseverance and attention with which Messrs. Jackson and Cary have for a considerable length of time been watching every opportunity to obtain the necessary materials for a scientific examination of these wonderful fishes, has induced me to commemorate the service they have thus rendered to zoology by inscribing with their names the two species now in my hands, and

which may be seen in my museum in Cambridge, labelled *Emb. Jacksoni* and *Emb. Caryi*.

A country which furnishes such novelties in our days, bids fair to enrich science with many other unexpected facts, and what is emphatically true of California, is in some measure equally true of all our waters. This ought to stimulate to renewed exertions not only our naturalists, but all the lovers of nature and of science in this country.

Family *Holconoti* or *Embiotocoidæ*.

The general appearance of the fishes upon which this family is founded, is that of our larger species of Pomotis, or rather that of the broader types of Sparoids. Their body is compressed, oval, covered with scales of medium size. The scales are cycloid, in which respect they differ widely from those fishes they resemble most in external appearance. The opercular pieces are without spines or serratures. Branchiostegal rays six. The mouth is encircled by rather thick lips; the intermaxillaries forming by themselves the whole margin of the upper jaw. The intermaxillaries and upper maxillaries are slightly protractile. Teeth only upon the intermaxillaries, lower maxillaries and pharyngeals; none either upon the palatines or the vomer. In this respect, as well as in the absence of spines and serratures upon the opercular pieces, they differ much more from the Percoids, than from the Sparoids; but the cycloid scales remove them at once from the latter, in which the scales present a very uniform ctenoid type. The thick lips might remind one of the Labroids, but the scales of the Embiotoca are neither elongated, nor provided with the characteristic branching tubes of that family.

One long dorsal fin, the anterior portion of which is supported by spinous rays, and the posterior by numerous articulated branching rays, which are sheathed at the base by two or three rows of scales, *separated from those of the body by a rather broad and deep scaleless furrow*. This last peculiarity has not yet been observed in any fish, as far as I know. There is indeed a distinct longitudinal space parallel to the soft portion of the dorsal, nearly of the width of a single row of scales, which is entirely naked and well defined, forming as it were, a furrow between the scales of the back, and those which rest against the base of the fin rays. Though protected in this way by a kind of sheath, the anterior part of the dorsal fin alone can be folded backwards and entirely concealed between these scales, as in many Sparoids; the posterior part only partially so. Moreover, the scales of the sheath are separated by a furrow from those of the back, only along the base of the soft part of the dorsal fin. The first rays of the anal fin are short, comparatively small and spinous. The base of this fin is strangely arched, and sheathed between scales, in the same manner as the dorsal; the spinous rays when folded back being more fully concealed in the sheath than the soft rays.

The ventrals are subthoracic as in the Sparoids, and provided with a strong spinous and five soft rays.

Four branchial arches, supporting four complete branchiæ with two rows of lamellæ in each. The opening behind the last arch is very small and entirely above the base of the pectoral fins. Pseudobranchia very large, and composed of sixteen or seventeen lamellæ. The alimentary canal is remarkably uniform in width for its whole length. It extends first on the left side as far back as the ventrals, turns forwards and upwards to the right, then follows the middle line along the *large air bladder*, to the second third of the abdominal cavity, then bends along the right side downward and slightly forwards almost to meet the first bend, when it turns backwards again, and ends in a straight course at the anus. The stomach can not at all be distinguished externally from the small intestine by its size and form. There are no *cæcal appendages at all* in any part of the intestine. The whole alimentary canal contained large numbers of shell fragments of small Mytili. The liver has two lobes, a short one on the left side, and a long one along the middle line of the body.

The female genital apparatus, in the state of pregnancy, consists of a large bag, the appearance of which in the living animal has been described by Mr. Jackson; upon the surface of it large vascular ramifications are seen, and it is subdivided internally into a number of distinct pouches, opening by wide slits into the lower part of the sack. This sack seems to be nothing but the widened lower end of the ovary, and the pouches within it to be formed by the folds of the ovary itself. In each of these pouches a young is wrapped up as in a sheet, and all are packed in the most economical manner as far as saving space is concerned, some having their head turned forwards, and others backwards. *This is therefore a normal ovarian gestation.* The external genital opening is situated behind the anus, upon the summit and in the centre of a conical protuberance formed by a powerful sphincter, kept in its place by two strong transverse muscles attached to the abdominal walls. The number of young contained in this sack seems to vary. Mr. Jackson counted nineteen; I have seen only eight or nine in the specimens sent by Mr. Cary, but since these were open when received, it is possible that some had been taken out. However, their size is most remarkable in proportion to the mother. In a specimen of *Emb. Jacksoni*, $10\frac{1}{2}$ inches long, and $4\frac{1}{2}$ high, the young were nearly three inches long and one inch high; and in an *Emb. Caryi*, eight inches long, and $3\frac{1}{4}$ high, the young were $2\frac{3}{4}$ inches long, and $\frac{7}{8}$ ths of an inch high. Judging from their size, I suspected for some-time that the young could move in and out of this sack like young opossums, but on carefully examining the position of the young in the pouches, and also the contracted condition of the sphincter at the external orifice of the sexual organs, I re-

mained satisfied that this could not be the case, and that the young Mr. Jackson found so lively after putting them in a bucket of salt water, had then for the first time come into free contact with the element in which they were soon to live; but at the same time, it can hardly be doubted that the water penetrates into the marsupial sack, since these young have fully developed gills. The size of the young compared with that of the mother is very remarkable, being full one-third its length in the one, and nearly so in the other species. Indeed these young *Embiotocæ*, not yet hatched, are three or four times larger than the young of a *Pomotis* (of the same size) a full year old. In this respect these fishes differ from all the other viviparous species known to us. There is another feature about them of considerable interest, that while the two adults differ markedly in coloration, the young have the same dress, light yellowish olive with deeper and brighter transverse bands, something like the young trouts and salmons in their Parr dress. The transversely banded species may therefore be considered as inferior to the other, since it preserves through life the system of coloration of the embryo.

It will be a matter of deep interest to trace the early stages of growth of these fishes, to examine the structure of the ovary and the eggs before fecundation takes place, etc., etc. The state of preservation of the specimens in my hands, precluded every such investigation.

Though I know thus far only one single genus of this type, I do not think it right to combine the generic characters with those of the family, as is generally done in such cases, as I would also object to the practice of omitting any specific characteristics where only one species is known of a genus. This shows an entire misapprehension of the relative value and subordination of the characters of animals. I would therefore characterize as follows the genus

Embiotoca, Agass.

Body much compressed and elevated. Head small, with scales only on the cheeks and opercular pieces. Teeth in both jaws, short, conical, arranged in one row, and slightly recurved. The pharyngeal teeth much shorter and blunter than those of the jaws, and arranged like pavement. Dorsal fin with nine or more spinous rays. The first three rays of the anal fin, spinous, and much shorter than the following articulated rays, which are always finer and more numerous than the corresponding rays of the dorsal fin. The lateral line is continuous to the base of the caudal fin. Whether the peculiar mode of reproduction is a family or a generic character, remains to be ascertained by further investigations. It is however probable that with some slight modifications it will be found the same in all the members of the family.

Some differences between the two species observed, might render it doubtful whether they ought to be considered as belonging

to as many distinct genera or not. But we know that in genera differing greatly from others, the range of the specific differences is also wider than in genera with many species; so until I am taught differently by new discoveries, I would refer them both to one and the same genus. Such doubts could scarcely be entertained respecting families with many genera, where a standard to estimate genuine generic differences is easily obtained.

1. *Embiotoca Jacksoni*, Agass.

The body is quite high, of an oval form, greatly compressed and similarly arched above and below. The superior arch extends to the posterior base of the dorsal fin, whence it continues in a horizontal line to the base of the tail. The ventral arch of the body is similar to that of the dorsal outline. The profile from the dorsal fin to the end of the snout, is rather precipitate and regularly arched, except obliquely above and in front of the eyes, where it is slightly concave. The greatest height of the body, including the dorsal fin, is equal to the distance from the end of the snout to the extremity of the pectoral. The greatest thickness of the body is equal to one-fourth its height. The head is of moderate size, its length, measuring to the posterior angle of the opercle, being about one-fourth that of the entire fish. The mouth is quite small, the hind extremities of the intermaxillaries and maxillaries extending not farther back than the line of the anterior border of the orbit. But a small portion of the superior maxillary is exposed at the angle of the mouth. The anterior edge of that part of the snout into which the intermaxillaries fit, is on a horizontal line drawn immediately below the orbits. The upper jaw is slightly more prominent than the lower, the teeth of the latter fitting *within* those of the former. In the upper jaw there are fourteen or fifteen teeth; in the lower there are two or three less. They all are slightly swollen near the top, and are not pointed but rather bluntly edged. They do not extend to the angles of the mouth, but leave a space without teeth on each jaw. The teeth of the upper jaw are but little larger than those of the lower. The teeth of the pharyngeals are much shorter than those of the jaws, and form two quite moveable plates above, and a triangular one below. There are not more than thirty teeth on each of the superior plates, and mostly truncated at the top. The four or five teeth, which form the inner row of each plate, are more prominent than the others, and somewhat pointed. The teeth of the inferior pharyngeal plate are similar to those of the upper, but the teeth of its posterior range are the most prominent, and pointed. The lips are rather fleshy, and entirely conceal the teeth. Beneath the lower lip there is an elongated pit on each side, extending towards the corners of the mouth; it is covered by a thin border of the lip. The distance from the end of the snout to the anterior border of the orbit, is greater than the diameter of the latter by one-third. The

inferior margin of the orbit is on the middle longitudinal line of the body; and its posterior border is half way between the end of the snout, and the posterior angle of the opercle. The opercular pieces are large. On the preopercle are four concentric rows of scales; the two inner and anterior are the longer. There are thirteen large scales in the row nearest the eye, and the number is less and less in the others. Still within the row nearest the eye, there is a space without scales, and marked by pores radiating from the edge of the orbit. The posterior and inferior border of the preopercle, outside of the ridge of the latter, is thin, membranous, and without scales, but marked with numerous pores or tubes similar to those around the orbits, and radiating from within outwards.

The opercle, subopercle, and interopercle are covered with scales, which decrease in size from the former to the latter. There is a narrow membranous border to the opercle, extending from its posterior angle to the height of the termination of the lateral line. The notch between the subopercle and interopercle is on a vertical line with the edge of the posterior border of the preopercle. There is a small patch of scales, nine or ten in number, immediately above the superior attachment of the preopercle. The dorsal fin extends over about $\frac{3}{5}$ ths of the superior curve of the body; its posterior portion is one-third higher, as well as longer, than its anterior. The spinous portion has nine or ten rays, the length of the first of which, is equal to one-third that of the last. At the point of each spine, the fin appears to extend backwards in a loose filament. There are $19\frac{2}{3}$ articulated rays in the dorsal fin: the superior outline of this part is nearly similar to that of the back, although the rays of its first half are the longest, and nearly equal in length. The furrow on each side extends as far forwards as the base of the first articulated ray, where there are three rows of scales forming the sheath; but the rows are reduced to one towards the posterior attachment of the fin.

The pectoral fins are of rather large size, and are placed below the middle line of the body, as well as below the posterior angle of the opercle. They extend about as near to the anal fin, as do the ventrals. The second ray of the pectoral is but slightly arched towards its extremity. There are twenty-one rays in each pectoral. The base of the ventrals is just in advance of the middle of this second ray of the pectoral. The spinous ray of the ventrals is $\frac{3}{4}$ th the length of the following articulated ray. There is a long plate of scales between the ventrals. The anal fin is broad and composed principally of fine slender rays. The last and longest of its spinous rays, equals in length $\frac{1}{4}$ th that of the following articulated ray, which latter is equal to the corresponding ray of the dorsal fin. The last ray of the anal fin is placed nearer the caudal fin than that of the dorsal. The fin itself reaches nearer the base of the tail. The caudal fin is deeply forked; it contains fourteen rays, omitting its outer and short rays. There are eight rows of

scales between the lateral line and the spinous portion of the dorsal fin, and eighteen rows below the lateral line in the same region. Sixty scales in the lateral line. Color uniformly dark olive brown, along the back, fading slightly upon the sides; dorsal black, mottled with white; caudal blackish, lighter upon the base; anal deep black, with a light longitudinal band; pectorals white; ventrals black with light base.

From the above description, it must be obvious that this is the species first observed by Mr. A. C. Jackson, to whom I have inscribed it, or at least a species very closely allied to it. There is only one fact about it which surprises me, that while he observed mature young in it on the 7th of June, Mr. T. G. Cary should have found it still with young as late as the beginning of August. Again Mr. Jackson saw nineteen young in it, whilst in the specimens forwarded by Mr. Cary, I found only eight or nine young, which were transversely banded like *Emb. Caryi*. May there be two species so closely allied as to be easily mistaken? I must add, that Mr. Jackson does not mention the mottled appearance of the dorsal, nor the light band upon the anal of his fish; which renders the supposition more probable that there are several and not only two species of this remarkable genus, about San Francisco. I would however, not forego the opportunity of connecting the name of Mr. Jackson with his interesting discovery, and have therefore called *Emb. Jacksoni*, that one of the species sent me by Mr. Cary, which agrees most closely with his description, leaving it for the future to decide whether this species is truly the one he first saw, a circumstance which is quite immaterial, since we already know two species of this extraordinary type.

2. *Embiotoca Caryi*, Agass.

The body is much more elongated than in *Embiotoca Jacksoni* yet equally compressed. Its height, including that of the dorsal fin, is less than the distance from the end of the snout to the extremity of the pectoral; and less than one-half the length of the fish. The profile is much less steep, and the snout quite as prominent, hence the head is longer than high. The posterior border of the orbit is nearer the angle of the opercle than the end of the snout. The upper and lower curves of the body are equal, and approach more nearly towards the tail, making this latter narrower than in the first species. The scales of the back do not descend upon the head lower than one-half the distance from the first spine of the dorsal to the end of the snout. The forehead is slightly concave as in *Emb. Jacksoni*. The posterior end of the intermaxillary does not extend as far back as the anterior border of the orbit. The nature of the lips, and extent of the upper maxillary is much as in the other species, but the anterior edge of the socket of the intermaxillaries is *above* the line of the lower border of the orbit. A vertical line through the orbit shows the

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height of the head in this region to be one-third less than in *E. Jacksoni*. The opening of the mouth is directed more obliquely upwards. The teeth are more slender, but have otherwise the same form. In the upper jaw there are twelve, in the lower eight teeth. The nasal openings are of tolerable size; one before the other, and in advance of the eye, but slightly below the line of its superior border. The vertical diameter of the orbit is less than its longitudinal; and its posterior border is nearer the angle of the opercle than the snout. The preopercle in this species is less rectangular than in the former. The inferior rounded angle of its *ridge* is in *advance* of the posterior margin of the orbit. The scales of the preopercle are also much smaller and less conspicuous. Tubes radiate from the border of the orbit and from the ridge of the preopercle, as in *Emb. Jacksoni*. The posterior membranous border of the opercle is narrower: the notch between the subopercle and interopercle is on the vertical line of the posterior border of the preopercle. There is a patch of scales above the superior attachment of the preopercle. The dorsal fin differs very little in form from that of the former, but extends somewhat farther forwards, its first spine being immediately over the posterior angle of the opercle. The distance from this spine to the end of the snout equals the distance from the same back to the ninth articulated ray. The posterior rays of the articulated portion, are shorter than in the first species, but they are more numerous by three rays. The pectoral has twenty-one rays; it is perhaps longer than in the other. The ventrals differ little. The anal fin however, differs greatly: it is very small and contracted, and is placed far behind the ventrals. The scales at its base form a waved outline much more marked than in *E. Jacksoni*. The spinous rays are very short, the last being less than one half the length of the following articulated ray, the base of which latter is directly under that of the fifteenth corresponding ray of the dorsal fin. Its posterior base and termination are as in the first species. The caudal fin however, is more slender, and more deeply notched. The scales of the body are by no means so large. The lateral line, follows the outline of the back, as in *E. Jacksoni*; there are seventy-five scales in it.

Color light olive, darker along the back; light brown longitudinal bands extend between the rows of scales, and darker transverse bands reach from the back to the sides of the body, not extending below the lateral line in the anterior part of the trunk, but more marked, and reaching nearly to the anal fin upon the tail. Head mottled black and white. Dorsal and caudal dotted with black and white. Anal with a large diffuse black mark upon lighter ground. Pectorals white. Ventrals white at the base, terminated with black.

Only one female has been observed, containing eight young. This species was discovered by T. G. Cary, Esq., in the Bay of San Francisco, in the beginning of August 1853.